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HIT Usage in Hospitals – An Investigation of Adoption Antecedents

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ABSTRACT

Thanks to the surge of health information technology (HIT) investment, hospitals have evolved into an IT-intensive industry. Hospital nurses and physicians spend much time working with computer-based clinic application systems in their daily undertaking of health care service, and the effective use of HIT becomes critical to the success of hospitals. Behavioral research on the adoption of HIT lags behind the fast proliferation of the technology. Many researchers frame HIT adoption with theories that have been validated in other industries without examining the special context of hospital operations. This research attempts to study the influence of hospital IT environment and personal IT knowledge on people's reactions to HIT systems. A research model was developed, and a field study at two midsized hospitals was conducted to test the hypothesized relationships. Implications of the results for both HIT researchers and practitioners are discussed.

Keywords

Health information technology, system integration, HIT adoption.

INTRODUCTION

In recent years, hospitals have been boosting their investments in information technology (IT) at an unprecedented pace. This is largely because IT, as evidenced in other industries, enhances operation efficiency and improves the overall profitability of business (Raghupathi and Tan, 1999; Chandra et al., 2013). Regulations and federal funding further promote the trend by imposing legal requirements and providing financial supports (Murphy, 2010). The surge of HIT investment helps hospitals evolve into an IT-intensive industry (Burke et al., 2002).

The deployment of HIT systems is necessary but not sufficient for transforming health care (Diamond and Shirky, 2008); to realize the technical potential and achieve desired outcomes, HIT needs to be fully adopted and effectively used (Kolodner et al., 2008). Behavioral research on the adoption of HIT lags behind the fast proliferation of the technology (Burke et al., 2002). Many researchers frame HIT adoption with theories that have been validated in other industries without examining the special context of hospital operations. In view of the lack of research relevance, Chiasson and Davidson (2004) called for exploring contextual influences on IS/IT within the healthcare setting.

This research attempts to study the influence of hospital IT environment and personal IT knowledge on people's reactions to HIT systems. A field study at two midsized hospitals was conducted to test hypothesized relationships. Implications of the results for both HIT researchers and practitioners are discussed.

THEORETICAL FOUNDATIONS AND HYPOTHESES

TAM Model and Technology Adoption

This research studies how hospital employees adopt HIT in their special operation environment. The technology acceptance model (TAM) serves as the theoretical foundation for framing the formation of behavioral intention of using a particular HIT system.

TAM was developed by Davis (1989) in an attempt to explain how individuals use a technological innovation in organizational settings. After two decades of intensive research, TAM is widely recognized as a dominant IS theory in the study of user behaviors (King and He, 2006). TAM posits that one's behavioral intention to adopt/use a certain technology is largely shaped by the person's attitudes (defined as the positive or negative fillings about the target technology), which is determined jointly by the perceived ease of use (defined as the expected effort of using the technology) and the perceived usefulness (defined as the assessment on the ability of enhancing his/her work performance) of the target technology. Furthermore, perceived ease of use will enhance one's perception on the usefulness of the technology; and the perceived

usefulness exerts a direct influence on one's intention of adopting/using the technology in addition to the effect of attitudes. The following hypotheses are developed to predict one's intention of using an existing HIT system.

H1. One's perceived usefulness of an HIT system is positively associated with the person's attitudes toward the HIT system.

H2. One's perceived ease of use of an HIT system is positively associated with the person's attitudes toward the HIT system.

H3. One's attitudes toward an HIT system is positively associated with the person's intention of using the HIT system.

H4. One's perceived usefulness of an HIT system exerts a positive effect on the person's intention of using the HIT system in addition to the effect of attitudes.

H5. One's perceived ease of use of an HIT system is positively associated with the person's perceived usefulness of the HIT system.

The IT Environment of Hospitals

The IT environment of hospital operations differ significantly from that of other industries. In this study, two aspects of hospital IT environment are examined: the conditions of hospital computers, and the integration of HIT systems.

Hospital Computers

Hospitals is an IT-intensive industry; hospital nurses and physicians spend much time working with computer-based clinic application systems in their daily undertaking of health care service, and "computers ... are conveniently located at every corner" (Chandra et al., 2013; p. 71). On the other hand, however, there are not many individually assigned computers in hospitals. Most hospital employees, nurses in particular, have to share computers with colleagues. Such a computer-sharing environment is rarely observed in other industries. Indeed, hospitals in general do not embrace the recent trend of "work from home" partially due to the practice of sharing computers in the workplace.

Another interesting aspect of hospital computers is the coexistence of different generations of computers and different versions of operating systems. This is largely caused by the complex nature of clinical application systems being used. Many clinical application systems are running on old computers with dated versions of operating systems (HIMSS 2012). However, due to strong computer-system dependence, replacing computers and updating operating systems cannot be done without profound support from system vendors.

Given the above discussion, two aspects of hospital computers should be investigated: computer access and computer performance. Computer access examines how easily a hospital employee can find a computer to work on. Computer performance assesses whether the performance of the computer meets the expectation of users. The two aspects of hospital computers reflect how computers are prepared to facilitate the use of HIT systems. With easy access to computers and quality computing performance, one's experience with a HIT system is likely to be smooth and manageable; a successful experience will in turn affects the person's attitudes and believes that direct future behavior (Bem, 1972). Similarly, if computers are not easily accessible and/or the performance of computers is poor, one will get frustrated during the work with a HIT system; the frustration will be transformed negatively to the development of key adoption believes, i.e., perceived usefulness and perceived ease of use of a target HIT system. The following hypotheses are developed:

H6. The preparedness of hospital computers in one's workplace will affect the person's perceived usefulness of a HIT system.

H6a. Computer access is positively associated with one's perceived usefulness of a HIT system.

H6b. Computer performance is positively associated with one's perceived usefulness of a HIT system.

H7. The preparedness of hospital computers in one's workplace will affect the person's perceived ease of use of a HIT system.

H7a. Computer access is positively associated with one's perceived ease of use of a HIT system.

H7b. Computer performance is positively associated with one's perceived ease of use of a HIT system.

Hospital HIT Systems

Hospital employees especially nurses often work on multiple HIT systems during their daily undertaking of health care service. The level of integration between HIT systems will affect one's experience with a particular HIT system, and in turn affect the person's further development of adoption believes toward the HIT system.

The IS literature has long recognized the importance of system integration, which refers to that functional information systems speak to each other and that functional activities are highly interrelated and handled together (Morabito et al., 2010). Integrated information systems help organizations not merely in automating business activities, but also reshaping and redesigning business processes (Venkatraman, 1991).

Healthcare is featured with fragmented services (Chaudhry et al., 2006). Clinic application systems are often developed in isolation to fulfil specific tasks. HIT systems are "... characterized as a series of standalone systems with little integration." (Burke and Menachemin, 2004; p. 208). The lack of system integration implies that hospital employees have to work on different systems to handle different tasks. Given the fragmented nature of healthcare and the large volume of transactions (Chaudhry et al., 2006), hospital employees will be frustrated with inefficiency when they switch between systems and cope with interrupted business processes. Such a frustration will affect the further development of adoption believes. Based on Morabito et al.'s (2010) study of IS integration, this study classifies system integration into three sub-categories: function integration that refers to integration across different applications and functions; communication integration that refers to the communication between systems; and data integration that refers to an integrated or shared access to data. The following hypotheses are developed:

H8. The level of integration of HIT systems in one's workplace will affect the person's perceived usefulness of a HIT system.

H8a. Function integration is positively associated with one's perceived usefulness of a HIT system.

H8b. Communication integration is positively associated with one's perceived usefulness of a HIT system.

H8c. Data integration is positively associated with one's perceived usefulness of a HIT system.

H9. The level of integration of HIT systems in one's workplace will affect the person's perceived ease of use of a HIT system.

H9a. Function integration is positively associated with one's perceived ease of use of a HIT system.

H9b. Communication integration is positively associated with one's perceived ease of use of a HIT system.

H9c. Data integration is positively associated with one's perceived ease of use of a HIT system.

IT Knowledge as Personal Factors

Behavior researchers have long recognized that one's behavioral intention is influenced not only by the consequence or the expected outcomes of the behavior, but also by a self-reflection of the competence that the person has on executing the behavior. Bandura (1977) developed a social cognitive theory to emphasize the role of self-referent thinking in guiding human motivation and behavior. According to the social cognitive theory, one will adopt/use an HIT system if the person believes he/she is equipped with the needed IT knowledge and skills. Such knowledge may come from two sources: system training and computer self-efficacy. System training refers to the training that one has received on using a target system. Computer self-efficacy is defined as one's judgment of his/her capability to use a computer (Compeau and Higgins, 1995); such judgment is often used as a surrogate measure of one's general IT knowledge in IS research (He and Freeman, 2010). With the system-specific knowledge (i.e., system training) and the general IT knowledge (i.e., computer self-efficacy), one will develop a self-reflective efficacy as a cognitive basis for the formation and development of perceived ease of use of the target system. The following hypotheses are developed:

H10. One's IT knowledge will affect the person's perceived ease of use of a HIT system.

H10a. The extent of system training that one has received is positively associated with the person's perceived ease of use of a HIT system.

H10b. One's computer self-efficacy is positively associated with the person's perceived ease of use of a HIT system.

The research model is graphically presented in Figure 1.

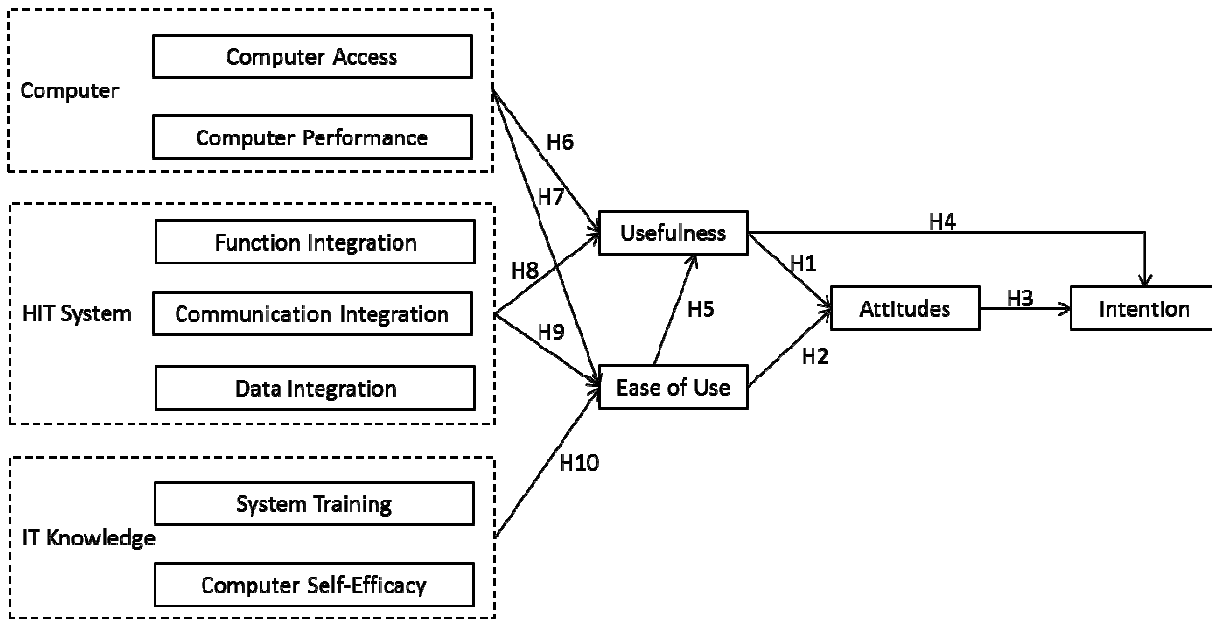


Figure 1. Research Model

RESEARCH METHODS AND RESULTS

Research Site

A field study was designed to test the proposed research model. Two midsize hospitals agreed to participate in the study. With the permission from the hospital management, survey invitations were sent to hospital employees via email. 271 people responded to the survey invitation. After dropping records with missing values, 151 answers remained for further analysis.

Measurement

The research model involves eleven constructs. The measurements of the four TAM constructs, including perceived usefulness, perceived ease of use, attitudes, and intention, were adopted from the Venkatesh et al. (2003). The measurement of computer self-efficacy was adopted from Thompson et al. (2006). The constructs of Function Integration, Communication Integration, and Data Integration were developed from the definition of system integration (Morabito et al., 2010). The operationalization of other constructs is explained below.

Computer Access is measured by three items asking the extent of computer sharing and the ease of finding a computer in workplace.

Computer Performance is measured by five items asking for the general performance of the computers in workplace, including the computing power and the processing speed.

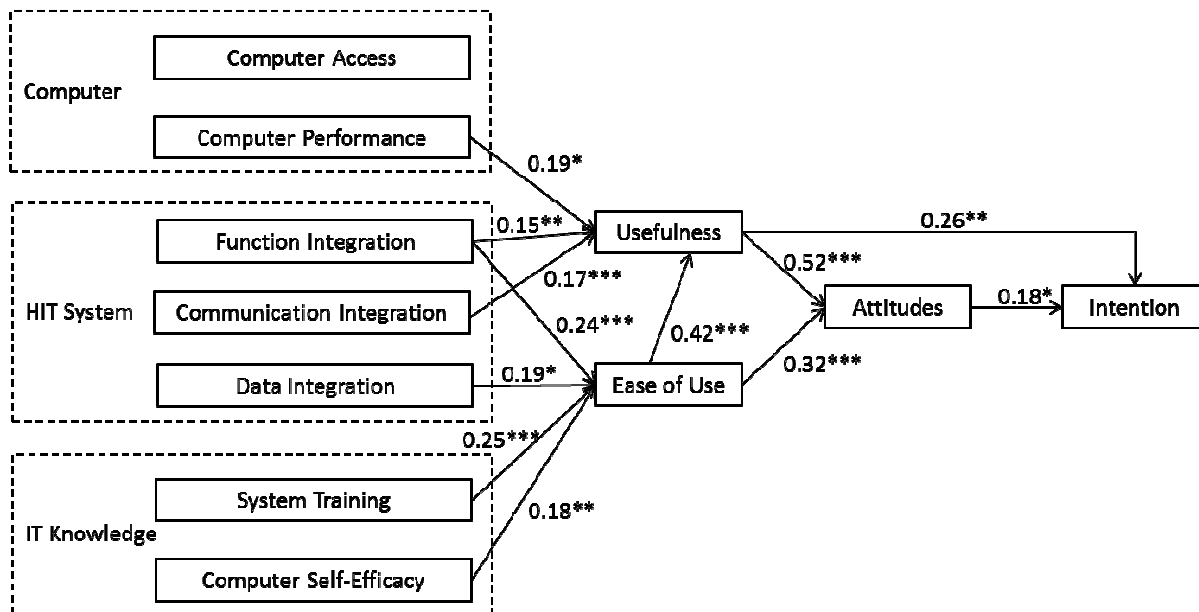
System Training was measured by three items asking whether one has received sufficient training on using a target system from training workshops, IT department, and/or other IT professionals.

Data Analysis

The test of construct validity was conducted with Partial Least Squares (PLS). Following the conventional practice, three aspects of construct validity were carefully examined. Construct validity was assessed by composite reliability calculated in PLS (should be larger than 0.70). Convergent validity was assessed by the average variance extracted (AVE) among measures (should be larger than 0.50). Discriminant validity was assessed by comparing the square root of AVEs and inter-construct correlations – the former should be larger than the latter to support discriminant validity. These statistics were calculated and examined (due to space limit, the statistics were not reported here); all the conditions were found to be satisfied. Thus, validity of the constructs under study was concluded.

Hypothesis Testing

The research model was tested with PLS-Graph 3.0. Some hypothesized relationships were found not significant at $p < 0.10$ level. The model was revised by dropping the insignificant paths. Figure 2 reports the revised model and the results.



Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Insignificant paths with $p > 0.10$ are dropped.

Figure 2. Testing Results of the Revised Model

Overall, testing results lend support to the proposed research model. The conditions of hospital computers, the level of system integration, and personal IT knowledge are found to affect one's reaction to a HIT system. Further examination of the test results is provided in the discussion section.

DISCUSSION

This research studies the antecedents of adopting/using HIT systems among hospital employees. Several IT environmental factors and personal factors are propositioned to affect people's key adoption believes, i.e., perceived usefulness and perceived ease of use of a target HIT system. The results are discussed below.

The Effects of Computer Access and Computer Performance

Computer access and computer performance as two aspects that describe hospital computers in workplace are propositioned to affect one's perceived usefulness and perceived ease of use of a target HIT system. The results show that only computer performance exerts a significant influence on the perceived usefulness. The finding suggests that the special practice of sharing computers at hospitals does not affect people's HIT adoption behavior. Although sharing computers with colleagues may seem inconvenient as one has to search for a computer in the workplace, people's perceptions of HIT systems regarding their usefulness and ease of use are not affected. However, computer performance does affect people's perception of HIT usefulness. Underperformed computers, either due to dated operating systems or due to limited computing power, will cause a disappointing performance of the target HIT system, and therefore affect people's perception toward the system. This finding suggests that assessing the functionality of an HIT system should take the associated computers into account; a same HIT system may be evaluated differently if different computers are used for running the system.

The Effects of Function Integration, Communication Integration, and Data Integration

The results demonstrate that the extent to which HIT systems integrate with each other strongly affect one's perception of a particular HIT system. The study investigated three aspects of system integration including multiple-task support, inter-system communication, and data sharing. For a special HIT system, function integration was found to affect both perceived usefulness and perceived ease of use of the system, communication integration was found to affect perceived usefulness, and data integration was found to affect perceived ease of use. The results suggest that HIT systems do not work in isolation;

whether a system is integrated with others will not only affect people's perception of the system per se, but also affect the perception of other systems being used in the same workplace. Hospital managers and system developers should pay special attention to the IT environment regarding the integration among different systems.

The Effects of Personal IT Knowledge

HIT systems are comprehensive information systems that require certain IT knowledge and skills for effective operation. The test results show that both system knowledge and computer self-efficacy exerts strong effects on one's perceived ease of use of a target system. The finding confirms the key proposition of social cognitive theory that one's ability of performing a behavior forms the cognitive basis of the person's decision on executing the behavior. Furthermore, the finding suggests that both a system-specific knowledge and a general IT knowledge are needed for using a HIT system. The former can be acquired by special training on the system, the latter is often accumulated through experience and related education. Thus, to promote a new HIT system in hospitals, system sponsors should consider both the general IT background of the target user group and the provision of special training workshops.

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